inhalation therapy

IN THIS ISSUE

Volume 5 Number 2

April 1960

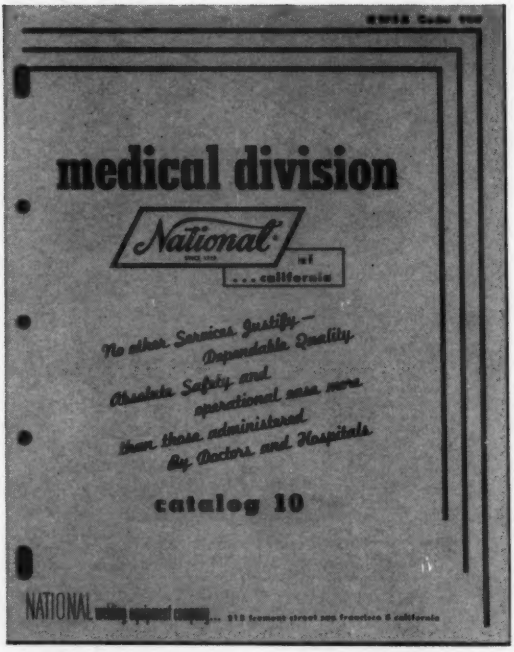
Part II of a three-part series on

Pulmonary Emphysema

The first of two articles on

Therapeutic Aerosols

JOURNAL OF THE AMERICAN ASSOCIATION OF INHALATION THERAPISTS



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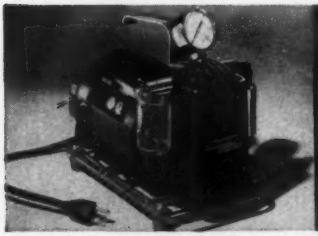

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*Smessaert, Andre; Collins, V.J.; and Kracum, V.D.: *New York Jour. Med.*, 55:1587, June 1, 1955.

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Editorial

Research and You

IT IS YOUR observations of patients and their treatments that are at the frontiers of inhalation therapy research today. If you think not, let us consider just what research is. Research is a search after knowledge. It involves ourselves as individuals.

When we put an oxygen mask on a patient and observe how it works and try to evaluate its effectiveness, we are doing research. By combining our findings on what happens in this mask-patient situation with those of other mask-patients, we augment our knowledge. When we have accumulated information we are in a position to communicate our knowledge, and to better understand the knowledge of others on this subject.

One of the fundamentals of research is to observe one variable when everything else is constant. A rough example is to study a bolt with a nut on it. We measure the distance the nut advances on the bolt when we turn it through one revolution. In other words, we've kept the bolt still and we've allowed just one variable—the revolution of the nut on the bolt.

But if we have that bolt in an engine in an automobile going 60 miles per hour, we have a completely different problem. This is typical of medical research; there are so many variables that it becomes difficult to control enough of them to permit measurements on one or a few. However, if we don't even try to observe, we will make no progress. We must at least make the *attempt*. This is more important than the result. Anyone engaged in formal research has the experience of doing a tremendous amount of "wasted" work. He gets an idea; he checks it; he finds it doesn't work; he tries another. He has considerably more ideas that *don't* work than do.

That work really hasn't been wasted; we profit by our mistakes and negative findings. And if we write them up as a report, somebody else reading it will be spared the time of trying this approach which we have shown leads the wrong way—or at least, it doesn't lead the way we *thought* or *hoped* it would. Sometimes these "negative" results lead, quite unexpectedly, to something very interesting and valuable which we might never have found if we had not made the effort.

One of the popular types of research these days is the statistical study. This may be done by elaborate data analyses requiring the calculations of complicated machines; but we can do it by simply repeating observations and recording them until there are enough of them to be significant.

By using refined methods like the so-called "double blind" technique, it is possible to arrive at unbiased answers to questions about the effect of certain forms of treatment. With this technique neither the patient nor the observer knows the details of the treatment. But even with this technique it is possible to fail—usually because of variables which were not controlled.

Another type of research involves mensuration—the development of ways to measure different things, like the amount of air being moved by a patient during pressure breathing, or ways to measure vital capacity during pressure breathing, and so forth. Unfortunately, there are often financial limitations on complex measuring instruments, but here is where your ingenuity is challenged to devise a means of accomplishing the measurement—at least in a practical way—without having to go into elaborate expenditure.

For example, we wish to check our humidifiers to find out whether they are performing adequately, or to compare the action of different humidifiers. By arranging a humidity-measuring instrument in an enclosed plastic sleeve and then passing the gas from a humidifier into the enclosed space, we can measure the relative humidity produced. Thus, we can compare different sorts of humidifiers, and can also check differences caused by different rates of flow. Granted, this is not a very precise way, but it is a very *practical* way of doing it. Not as impressive as research involving fancy and expensive equipment, perhaps, but from a clinical and practical standpoint, *it yields usable results*. This is research that every one of us could do, and should be doing.

One of the important things about mensuration is that one must not conclude from measurements alone that one situation may be better *clinically* for the patient than another. We have to be very careful not to assume that just because we have measured something that we don't come up with the preconceived idea that one of these conditions is better than another. With respect to the pressure breathing, for example, spirograms made under one set of conditions may reflect greater ventilation than under another set of conditions. It might, therefore, seem logical to conclude that pressure breathing under the first conditions would be better for the patient than under the second. *Clinically*, though, it might be found that the patient does not tolerate the procedure under the first conditions at all well, and that he derives more benefit under the second conditions.

Remember, research is not confined to the laboratory; the confines of research are limited only by the *individual*. All of us should be seeking after knowledge, and as we seek after knowledge by observing our therapy, we *are* doing research.

—Albert H. Andrews, Jr., M.D.

AMERICAN ASSOCIATION OF INHALATION THERAPISTS

THE AMERICAN ASSOCIATION OF INHALATION THERAPISTS is an organization of therapy technicians working: In hospitals, for firms providing emergency therapy service, and for municipal organizations. The Association is sponsored jointly by the American College of Chest Physicians and the American Society of Anesthesiologists. Three doctors from each group comprise the joint Board of Advisors to the AAIT, which has nearly 900 members in the United States, Canada, and several countries abroad.

The length of this monograph requires that we divide the condensation into three parts. Part I, which we published in February, dealt with a description of the ailment; Part II, here, discusses testing, and CO_2 narcosis and respiratory acidosis. Part III, to be published in June, will deal with the treatment of the disease. (Condensed from CIBA CLINICAL SYMPOSIA, *Volume 10, Number 6, and reprinted with permission of that publication and the authors, Drs. Farber and Wilson).*

Pulmonary Emphysema: Part II

Possible ventilatory increase for emphysematous patient is limited

by Seymour M. Farber, M.D. and Roger H. L. Wilson, M.D.

THE RECORDING spirometer is a simple apparatus that will record the volume of air and the time used to complete both inspiration and expiration. Plate I compares the typical recording of the normal individual with that of the patient with emphysema.

In the normal individual, the line goes up more or less steeply as the patient inspires. As the breath is let out completely, the line falls away sharply, about 95% of the air being expelled in the first three seconds. Then comes a very short period of rest before a second inspiration.

Dr. Farber, left, is assistant dean, University of California Medical Center (Continuing Education), chief of the University of California tuberculosis and chest service at San Francisco General Hospital, and president of the American College of Chest Physicians. Dr. Wilson is assistant clinical professor of medicine, University of California School of Medicine in San Francisco, and is in charge of the pulmonary physiology laboratory on the University of California Service, Ward 62, San Francisco General Hospital, San Francisco, California.

In the emphysematous patient, the air is inspired almost as quickly but fails to attain nearly the height reached in the normal. The major difference in emphysema is the prolongation of expiration caused by collapse of the bronchi that we have described earlier. In this case, 8 to 12 seconds or more are required for total expiration. This leaves the patient breathless so that without any waiting period he hastens to inhale the succeeding breath.

The period of quiet breathing that follows is closer to the level of full inspiration than before the test. *The fastest component of expiration is near the point of fullest inflation, since the bronchi are kept open most widely when the lungs are fully inflated, and the negative pressure in the pleura is greatest.* A patient with emphysema can only breathe rapidly in the position of full inflation.

This test takes less than five minutes. It provides immediate information as to the patient's respiratory status, practically making the diagnosis. *If the patient has the type of expiration shown in the upper tracing on Plate I, and it fails to improve*

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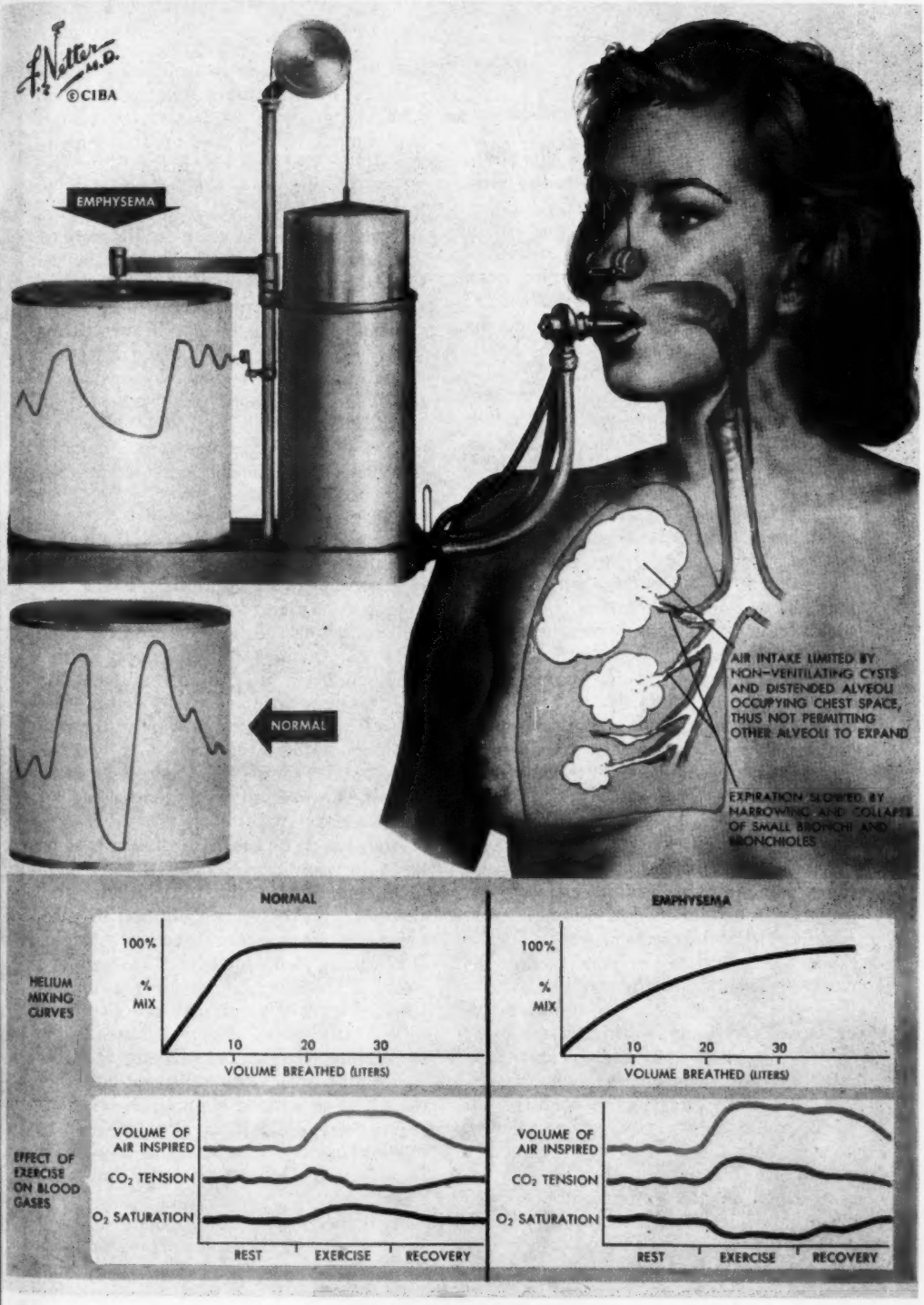

PLATE I—PHYSIOLOGIC TESTING

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with bronchodilators, that patient has emphysema and must be treated accordingly.

Also on Plate I are shown the changes in the mixing of gases that occur in the lungs of patients with emphysema. To determine the rate of mixing, a closed-circuit spirometer containing helium is used. As the patient breathes into this spirometer, the content of helium can be determined continuously. From this can be found the rate at which helium mixes with the air in the lungs.

In the patient with normally functioning alveoli, the helium will mix rather rapidly with the air already present in the lung. Within two minutes of quiet breathing the normal lung may be within 20% of complete equilibration. On the other hand, as will be seen in the curve on the right, mixing takes place much more slowly in the patient with emphysema. This is due to the many poorly ventilating areas in the emphysematous lung. Indeed, where a large non-ventilating cyst is present, complete mixing may take as long as an hour. While this test need not be used routinely, it does indicate quite graphically what an inefficient mechanism for gaseous exchange is the emphysematous lung.

The curves at the bottom of Plate I show the effect of exercise on blood gases in emphysema. In the normal individual the volume of air inspired increases on exercise but falls toward normal fairly rapidly during the recovery phase. On the other hand, due to the poor facility for gaseous exchange in the emphysematous lung, the patient with this condition increases his volume of inspired air more sharply; it reaches a higher level and returns to normal far more slowly.

At the same time, in the normal with plenty of respiratory reserve, the CO_2 level goes up only slightly and very transiently on exercise. The oxygen saturation is actually increased. In emphysema, on the other hand, despite the increased ventilation the CO_2 tension in the blood increases and the oxygen saturation falls, both returning slowly to normal on rest.

It must be remembered that there is a limit to the increase in ventilation that is possible to the emphysematous patient. Also, the range of respiratory movements is in a more inflated position, thus making the dilution of the air in the lungs less adequate with each breath. In addition, the increased ventilation requires a considerable increase of effort by the patient. This effort increases the production of CO_2, as well as requirement of oxygen, so the *net gain from each breath is further reduced.* Lastly, there may be ventilating areas in the lung which have lost their blood supply and which take up part of the breath for no useful purpose. All of these factors contribute to the oxygen desaturation and the increased accumulation of CO_2, despite the increased ventilatory rate that occurs on effort.

Oxygen and Carbon Dioxide Exchange. Referring to Plates II and III the interrelationships of oxygen and carbon dioxide exchange in different areas of the emphysematous lung can be visualized. Looking at the oxygen and CO_2 situations of normal lung, one sees that all alveoli ventilate easily and are of such a size that at the end of expiration the blood flowing in the pulmonary capillaries is almost fully saturated, and CO_2 is still passing into the alveoli. However, in emphysema great disorders exist.

Alveolus A in the case of emphysema has a very low oxygen content and a high CO_2 content. It fails to ventilate and, therefore, makes no contribution to gaseous exchange in either direction. Alveolus B ventilates well. However, it has no blood supply. Therefore, it contains a normal inspired level of oxygen but practically no CO_2. This alveolus also contributes to the respiratory dead space. Alveolus C in the atelectatic area does not ventilate, nor does it have a blood supply. Therefore, it makes very little, if any, contribution to gas exchange. In the series of alveoli D_1, D_2, D_3, and D_4, one sees the following changes:

Alveolus D_1 does not ventilate well but has a normal blood supply. Therefore, it is low in oxygen and high in CO_2. Blood from this alveolus will thus tend to decrease the

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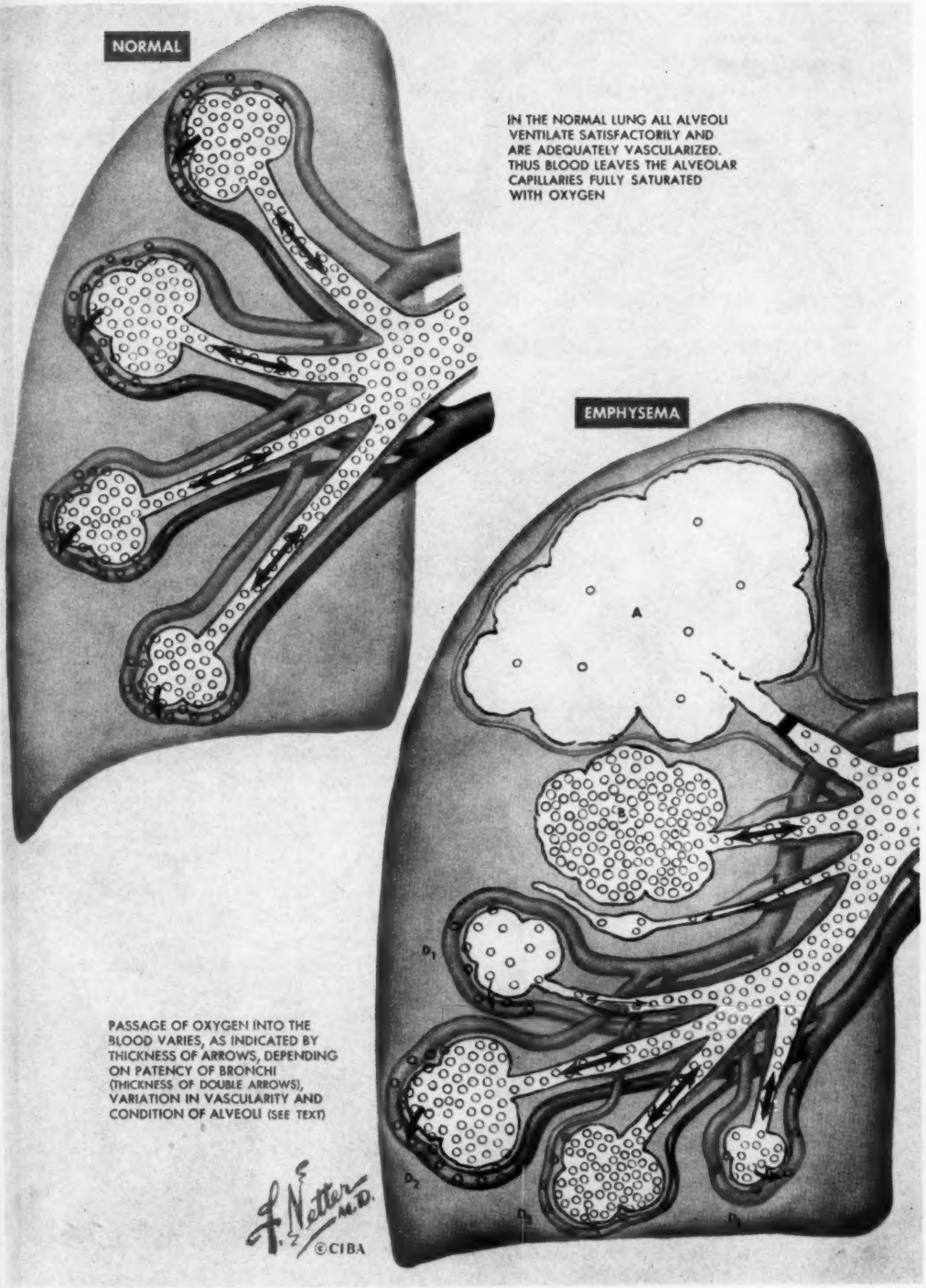

PLATE II—OXYGEN EXCHANGE IN NORMAL AND EMPHYSEMATOUS LUNGS

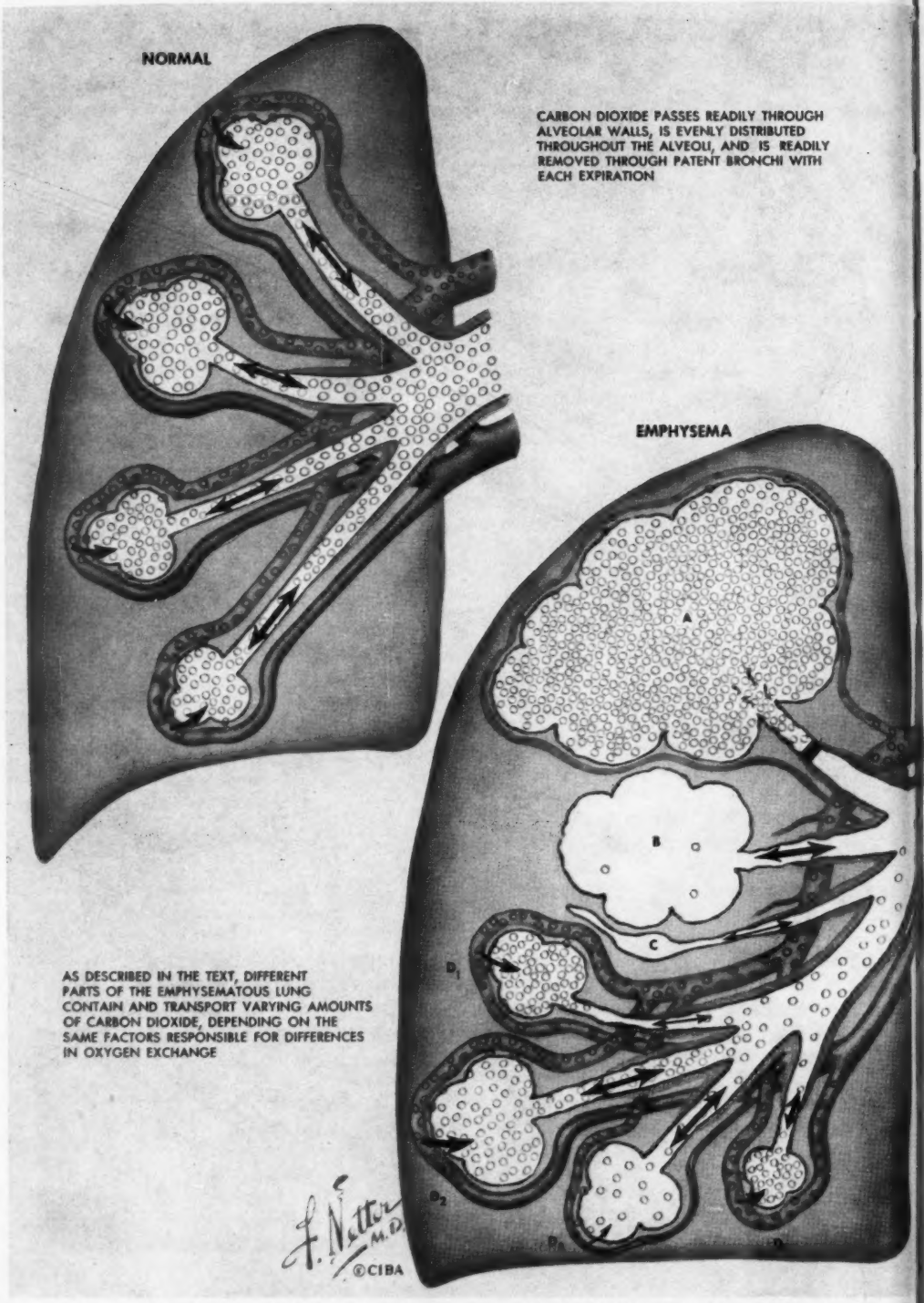

PLATE III—CARBON DIOXIDE EXCHANGE IN NORMAL AND EMPHYSEMATOUS LUNGS

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oxygen saturation and increase the CO_2 tension of the pulmonary return to the heart.

Alveolus D_2 is a fairly normal alveolus, except that it is rather large. It is ventilating adequately and is well perfused. Thus this alveolus returns blood to the heart that is fully saturated and contains little CO_2.

Alveolus D_3 is a normally ventilating alveolus but has a small blood supply. Therefore, it will be high in oxygen concentration since oxygen is not removed as completely as in D_2, and it will be low in CO_2 content because the possible CO_2 take-up is limited by the decreased blood flow. Although the blood coming from this alveolus will be fully saturated and will have less CO_2 than normal, it will not contribute as much as it should to the total flow of blood from the lung.

Alveolus D_4 is a small one. At the end of expiration the oxygen is almost completely used up. It is well ventilated. Through a whole respiratory cycle, such an alveolus will give rise to some incompletely saturated blood, although by and large most of the CO_2, but perhaps not enough, will have been taken off.

These are some of the permutations and combinations of ventilation and blood perfusion that give rise to the abnormalities of gaseous exchange in pulmonary emphysema.

Respiratory Acidosis and Carbon Dioxide Narcosis. Chemical control of respiration in mammals is governed by the levels of carbon dioxide in the blood, an excess of oxygen always being available. Normally, when the carbon dioxide level rises, breathing becomes deeper and more rapid, and the excess CO_2 is "washed away." However, with the development of respiratory insufficiency in emphysema, the patient is unable to keep the carbon dioxide level within normal limits, despite all his efforts.

The effect of an excess of almost any stimulant is depression. So it is with the respiratory stimulant, carbon dioxide. When the medulla becomes overloaded with CO_2 (almost twice normal concentration), the respiratory center becomes depressed, and breathing becomes more shallow rather than deeper.

When the respiratory center becomes depressed or anesthetized by the overload of carbon dioxide, the secondary mechanism—fall of arterial blood oxygen tension—takes over. This is probably a relic of those amphibia in which respiratory regulation depends primarily on the oxygen tension of the blood. It is relatively much less efficient, capable of only barely meeting the needs of the patient.

As the respiratory center and other parts of the brain become more and more depressed or anesthetized by the overabundance of carbon dioxide, the physician must be more careful in the administration of oxygen since this may remove the only stimulus to breathing which is left.

Since carbon dioxide retention or respiratory acidosis is always serious and is a common cause of death in these patients, it must be detected early, adequately treated, and prevented if possible.

THE AAIT OBJECTIVES

The American Association of Inhalation Therapists is an international organization of therapy technicians working: In hospitals, for firms providing emergency oxygen therapy service, and for municipal organizations. The Association's objectives:

1. To encourage and develop educational programs for people interested in the field of inhalation therapy;
2. To advance the science and art of inhalation therapy through institutes, meetings, lectures, and publications (including this Journal);
3. To aid the advancement of the technical aspects of inhalation therapy; and
4. To facilitate cooperation between inhalation therapists and the medical profession, hospitals and other agencies interested in inhalation therapy.

The AAIT is jointly sponsored by the American College of Chest Physicians and the American Society of Anesthesiologists. Three doctors from each group comprise the joint Board of Advisors to the AAIT.

Nature of aerosol determines its therapeutic effectiveness

by Joseph B. Miller, M.D.

Dr. Miller discusses the nature of aerosols in this first of a two-part series. In June he will describe the most effective ways of applying therapeutic aerosols.

A KNOWLEDGE of the fundamentals of aerosol therapy is very essential to its rational administration. These fundamentals are based on the very nature of the aerosol droplet, which behaves differently from gases.

First we must straighten out three words which are used interchangeably and which are not really the same things at all. The first is *vaporization*. It is not correct to call an aerosol a vapor; vaporization is the production of a vapor or *gas*, and an aerosol is not a gas: *it is a suspension* of liquid droplets or solid particles *in a gas*. Vaporization really is just evaporation.

The second term, *atomization*, describes methods of breaking liquids or solids up into tiny particles, such as are generated from the spray nozzle of an atomizer or the centrifuge head of a Walton humidifier. These devices produce a wide assortment of particle sizes, many of which are too large for practical use, and which constitute a nuisance because gravity makes them "rain out."

Nebulization (or aerosolization) consists of atomization with the added refinement of removal of the larger particles by baffles. The baffle knocks down the larger droplets and only those light enough to float around it emerge from the nebulizer as a cloud of aerosol. So the term *aerosol* applies to *floating* particles or droplets.

Components of the Nebulizer. Briefly, the aerosol generator, or nebulizer, is comprised of a fluid reservoir, the atomizer jet or jets, and the baffle(s). There are openings for the entry of the driving gas and exit of the aerosol, and sometimes an air intake vent. There may be additional attachments, such as nose pieces or rubber hoses. Finally, there must be a source of pressure, which may come with the nebulizer (rubber hand bulb) or may be separate (air compressor or cylinder of gas).

Droplet Size and Site of Deposition. The most important thing about an aerosol is its droplet size. If the particles are too large, their very weight will make them fall out; their floating is too transient. On the other extreme, if they are too small, they will be inhaled and then exhaled again like smoke, because their mass is not sufficient for centrifugal force to throw them out as they make their turns through the twisting branches of the

Dr. Miller specializes in pediatrics and pediatric allergies. He is a research associate at Spring Hill College, Mobile, Alabama; a Fellow, American Academy of Pediatrics; a Diplomate, American Board of Pediatrics; an Associate Fellow, American College of Allergists; a member, American Academy of Allergy.

respiratory tree.

Between these extremes, the site of deposition of these droplets depends on their size: the larger droplets deposit higher, some of the smaller droplets are able to go deeper into the respiratory passages (Figure 1). So droplets of 30 micron diameter or larger are deposited in the mouth, larynx and trachea. Except by dripping or running on down, they reach no farther than the trachea. Droplets of *all* sizes *begin* to be deposited from the first turn in the pharynx—even some of the very smallest ones. But the smaller they are, the more of them are able to float on farther.

Droplets of 30 down to 10 microns are able to reach the bronchioles; those from 10 down to 3 micra are deposited all along the way, and as far as the alveolar ducts. Three to 1 micron diameter ones can reach into the alveoli; while those of only 0.5 micron or smaller diameter are so light that 50% or more of them float around without being deposited at all, and are exhaled again.

Therefore we could say that the droplet size to be generated would depend on where the pathology is that you're trying to treat. But as a matter of fact, if you make the droplets small enough, they're going to be deposited all along the way. This has an advantage, in that it's more widespread—it goes deeper. But it has a disadvantage also, and that is that these smaller droplets have much less *mass*. That is, much less material in them. The mass of a droplet is proportional to the cube of its radius, so that a droplet having a radius just twice as large as another droplet's radius will have eight times more mass.

So if we are going to use aerosol therapy and we want to use a droplet size that is effective—i.e., the smaller size—we have to realize that we are depositing only very tiny droplets and that, except for very potent pharmacological agents, we must give *long* treatments to get enough down there. There is no such thing as an effective treatment in only 5 or 10 minutes with Alevaire or any other aerosol which acts by physical effects rather than pharmacological effects. And from this it follows that there is no such thing as using one of these physically acting agents with a hand bulb nebulizer, because you couldn't nebu-

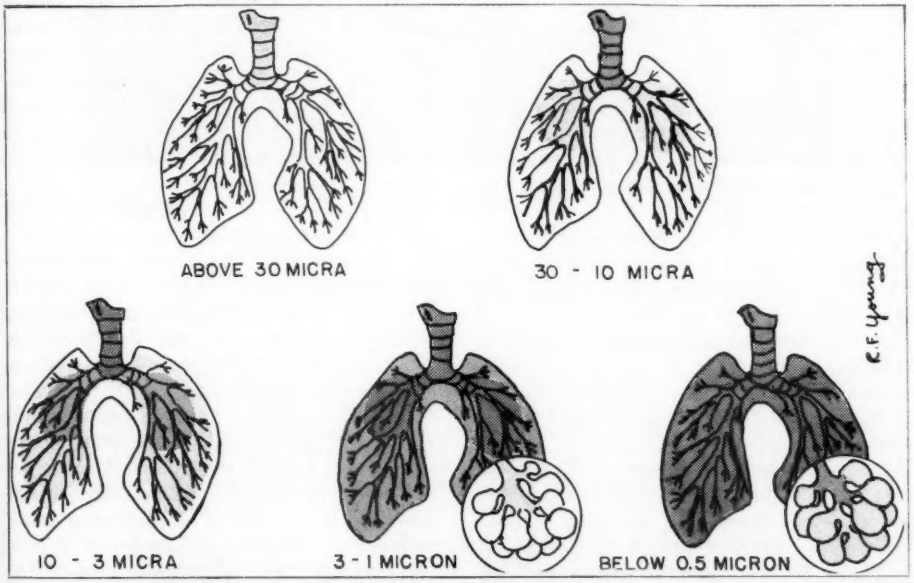

Figure 1. Diagram of the lungs shows areas of deposition of aerosol droplets of different size. Numbers refer to droplet diameters (1 micron = 0.001 millimeter). Heaviest shading indicates heaviest deposition.

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lize enough of it squeezing a rubber bulb to do any good. Twenty to 50 cc would be required to produce much effect, and it would take a week to give such a dose with a hand bulb nebulizer!

Factors Affecting Droplet Size. These are the jet, the baffles, and their relationship to each other.

If the air jet orifice is large, most of the particles will be large. If then you baffle the large ones out, what will come out of the nebulizer? Very thin, light mist, not enough to do much good. So we reduce the orifice size, but the driving gas pressures available to us put a limit on how small we can make it. It is hard to get much through a very small orifice unless pressures are higher than standard equipment furnishes. However, it is possible within the available pressures to make the orifice small enough to give a fairly small particle size range.

Now the baffles. If there is only one, there is too good a chance that some of the larger particles can get around it and will then rain out on the patient. I feel that the ideal number of baffles is two or possibly three. This of course can vary with the type and placement of the baffle. If it is placed in such a way that it makes the current of aerosol turn only a few degrees, then it's not nearly as effective as one that makes the aerosol turn 180°, completely reversing its direction of flow before it's blown on out of the nebulizer.

There is one other factor regarding baffle placement which is often overlooked, and this is that a droplet traveling through the air tends to break up by itself. High speed photography has been utilized to demonstrate this. If a single large droplet traveling through the air (as it does from an atomizer nozzle) is allowed to go far enough without condensing out against a surface, it tends to break up into many smaller ones, just by friction with the air. Practically, this means that if the baffle is set too close to the jet, it will drown out a large part of the aerosol which could be realized by placing the baffle farther away and letting the aerosol be formed by expansion, rather than trying to break it up by bouncing it off a baffle. A large droplet striking a surface is more likely to condense out than it is to break up into smaller ones.

Volume of Output. The next most important thing about an aerosol after droplet size is its *density*, i.e., the number of droplets per unit volume, which is a function of the nebulizer. Obviously, with a physically acting aerosol, the results are going to depend on getting plenty of them into the patient, particularly when the only ones that are effective are the smallest ones—the ones with so little mass.

Therefore, a very dense floating mist is required; it *must* be dense. I don't mean simply that a nebulizer has to spray 100 cc per hour out of its reservoir, because that 100 cc might be mostly in the form of large droplets. It must be a thick, floating fog, and the larger the output, the better the results will be.

How can the output be measured? Put 100 cc of solution into the reservoir of the nebulizer, run it for one hour under standard conditions, and then measure what is left in it. Make sure in the meantime that it is not putting out rain size particles. I don't mean to try to study these particle sizes in the complex way that is necessary to really determine their diameters; but simply by placing a sheet of filter paper under the aerosol stream as it emerges, and noticing whether droplets deposit out onto the paper, or by holding your hand in front of the mist and seeing if it gets wet (which it shouldn't if the proper size particles are coming out). These are things that anyone can do with no equipment at all, and yet they are very practical.

Factors Affecting the Volume of Output. As with droplet size, the volume of output of an aerosol generator is influenced by the jets and the baffles. The finer the jet, the more small particles, but this is subject to the limit already mentioned. It is possible to overbaffle too. If you put sufficient number of turns between the jet and the patient, the amount of aerosol reaching the patient is diminished.

Another factor profoundly affecting the

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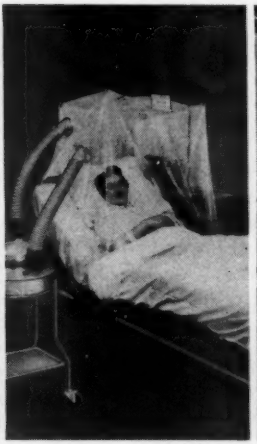

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continued from page 20

volume a nebulizer will put out is the air vent on the side of the nebulizer. The closed nebulizer such as we use on IPPB machines has an output of only about 5 cc per hour. But the DeVilbiss 40 and Vaponephrin hand nebulizers, which have just about the same jets and the same internal construction, have a little side vent about a quarter inch in diameter, through which air can be drawn into the nebulizer. *With the stopper out of that vent, the output of aerosol is more than doubled per unit time.* The larger the vent, the greater the output. The Hi-Flow nebulizer, which has a vent of one and one-fourth inches, has an output of 60 cc per hour of floating droplets.

Deposition of Aerosol within the Patient. Results of therapy, of course, depend on the amount of aerosol finally deposited in the patient. How can this be measured? Well, there have been many complex methods of doing this, but there is one very simple way, and this is the Phenol-sulfon-phthalein method. Phenol-sulfonphthalein (PSP) is a red dye used intravenously for kidney function tests (the normal kidney promptly excretes it), and the company that makes it will supply a stronger concentration that can be used as an aerosol. So if it is put in a nebulizer and the aerosol is inhaled, the dye which deposits in the lungs will be absorbed into the bloodstream and then excreted by the kidneys. Not quite 100% of that deposited will be recovered this way, because for the first 24 hours after the treatment, any sputum expectorated will be stained red.

Repeating this technique under standardized conditions, relative or comparative values can be worked out for various nebulizers and times of exposure to aerosol, so that one can determine the efficiency of the techniques or types of equipment in depositing the material. It is only necessary to collect the urine and then add the proper reagent to turn the PSP red again (it doesn't always come out red, but adding the reagent will restore the color). Then a sample of this is "read" in a colorimeter—an instrument which compares the relative intensities of colors—and the percentage deposition of aerosol can be found by a simple calculation based on the colorimeter reading.

This has been done for quite a few different nebulizers and techniques, to compare administration by direct nasal, direct oral, little masks, big masks, face hoods, small tents, large tents, and so on.

Factors Affecting Deposition in the Patient. These are quite complex. In general they are:

(1) *Baffling* between the nebulizer and the lungs. Hoses or ducts passing from aerosol generators to the patient should be as short and straight as possible, and ought to have a diameter no smaller than the output port of the nebulizer. Otherwise, there is considerable choking-down of the aerosol and deposition on the walls of the conducting tubes. Even after it reaches the upper airway, eddying and whirling about tends to throw droplets out by centrifugal force.

(2) *Dilution* by the air in the tent, incubator or other container the aerosol is led into.

(3) *Air currents.* With regard to tents, air currents are the worst factor. Nebulizing an aerosol into an oxygen tent with a motor-driven air circulating mechanism is a waste of time. To get a dense, therapeutic aerosol, it is necessary to turn off the circulating fan. This raises the problems of rising temperature and CO_2 accumulation in the tent. On the other hand, if the fan is left on, in addition to the problem of the aerosol being blown away, there is the difficulty of deposition of aerosol on the cooling coils of the tent, with resulting debility of the cooling system.

(4) *Temperature.* One way to increase deposition is to give *warm* aerosol. Warm breath blown onto cold glasses condenses on them. An aerosol behaves the same way: the warmer it is as it reaches the warm bronchial mucosa, the better it will deposit. Of course, in the case of tents and incubators, the patient won't tolerate much heat; but when it's being inhaled directly into the nose or mouth, *it is actually more soothing to inhale a warm aero-*

sol than a cool one.

(5) *Evaporation.* Atomized droplets of 10 microns diameter evaporate within 0.02 seconds after leaving the nebulizer. When water is nebulized, it can be seen that the mist disappears completely within a few inches of the nebulizer. This happens not only with water, but with any aqueous solution of a drug, *unless it has something in it to prevent evaporation.*

And what will prevent evaporation? Any hygroscopic agent. The most commonly used and least toxic substance is glycerine. It is also happily the most effective, because a small quantity of glycerine stabilizes droplet size and keeps

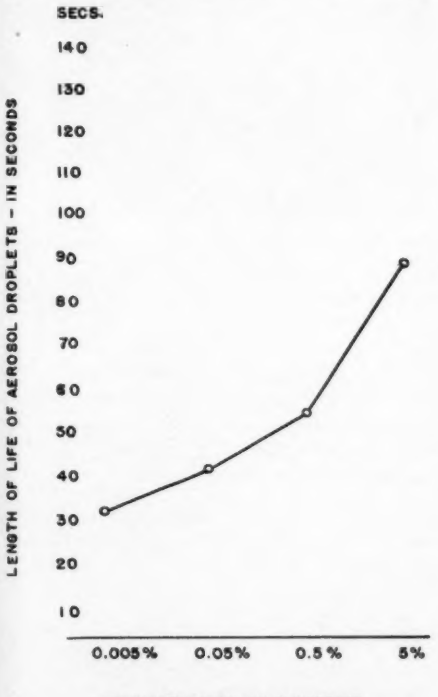

Figure 2. As concentration of glycerine increases, lifetime of droplets, measured in seconds, increases.

them from evaporating much better than even a much larger amount of any of the other hygroscopic agents similar to glycerine.

The question now is, how much retardation of evaporation is desired? That is, what is the optimum droplet lifetime—the one which uses the minimum of glycerine and yields the maximum therapeutic result? Space does not permit detailing here the methods for determining droplet lifetime, but the accompanying graph (Figure 2) shows that 5% glycerine will yield droplets having a lifetime of 90 seconds, which other tests showed was the optimum time for overcoming the disappearing effect of an aerosol caused by evaporation of droplets faster than they can be replaced by more from the nebulizer.

(6) *Surface tension of droplets.* Whereas water droplets unstabilized by a hygroscopic agent tend to evaporate before they can be deposited, the addition of

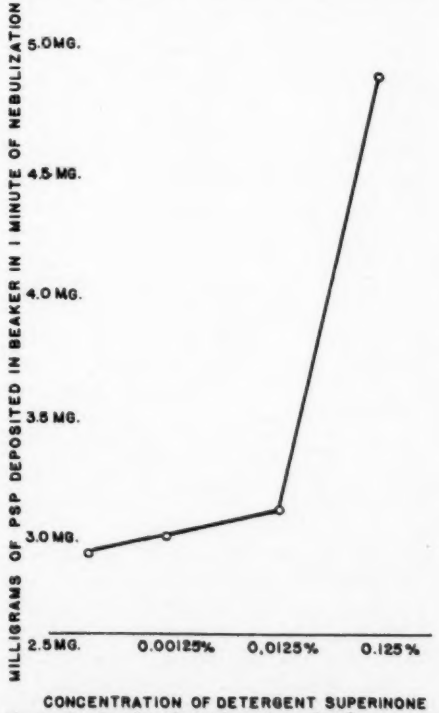

Figure 3. Droplet deposition rises sharply as concentration of detergent Superinone passes 0.0125%.

hygroscopic stabilizing agents like glycerine imparts a surface tension to the droplets which makes them tend to bounce off surfaces and float away again. When studying deposition, we put PSP into the glycerine aerosol and aimed it into a

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CHAPTER ACTIVITIES

by Jack Sangster

THE SECOND annual workshop and lecture series was held by the **Bay County (Michigan) Chapter** and the **Michigan Society of Inhalation Therapists** jointly on April 7 at the Olds Hotel in Lansing.

Speakers and their topics included: Norman S. Talner, M.D., assistant professor of pediatrics and communicable diseases, University of Michigan, "The Use of Nebulized Solutions in Treating Cystic Fibrosis and Other Pediatric Conditions"; John W. Ditzler, M.D., assistant chairman of the anesthesia department, Henry Ford Hospital, Detroit, "Management of the Patient Using the Various Types of IPPB Apparatus"; Don E. Gilbert, chief inhalation therapist, University of Michigan Medical Center, Ann Arbor, "The Organization of Inhalation Therapy Service in the Hospital"; T. E. Andridge, manager, Central Services, Battle Creek. "Inhalation Therapy Service in the Home"; and Mary Lou Byrd, M.D., senior attending anesthesiologist, Butterworth Hospital. Grand Rapids, "The Use of High Humidity in Inhalation Therapy."

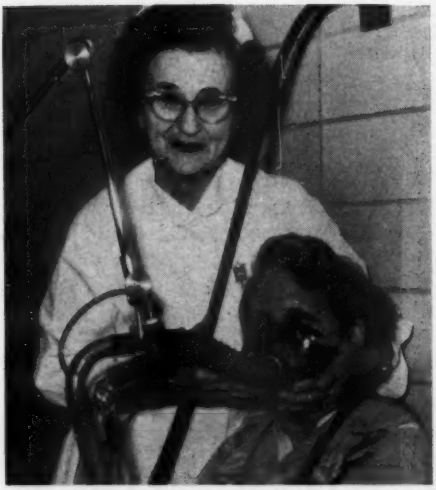
At the annual business meeting of the **Delaware Valley Chapter,** Walter D. Palmer, Children's Hospital, Philadelphia, was elected president.

Other officers chosen were: Robert A. Cornelius, Wilmington (Delaware) General Hospital, vice president; and Robert J. Walters, Memorial Hospital, Wilmington, secretary-treasurer. Thomas W. Cripps, Hospital of the University of Pennsylvania, Philadelphia, was named to the board.

The **Western New York Chapter** will hold its second annual institute on Tuesday, May 17, at the Sheraton Hotel in Rochester. Registration is $4. Full information may be obtained from Edward P. Flynn, 133 Spruce Avenue, Rochester 11, New York.

The **Illinois Chapter** held its third annual clinic-workshop at Chicago's Edgewater Hospital in February.

The first day was devoted entirely to tents and aerosols. The program on the second day included lectures on IPPB, ex-



Mrs. Agnes M. Forrest, director, inhalation therapy department, Edgewater Hospital, Chicago, gives a positive pressure treatment to a "patient" during the Illinois Chapter's third annual clinic and workshop.

suffla-resuscitation, respirators, hyperventilation, pulmonary physiology, and nursing-inhalation therapy inter-relationships. Demonstrations and exhibits of equipment were featured, as well as group tours of the inhalation therapy department.

More than 150 people attended the **Southern California Chapter's** evening educational program held February 3 at St. Vincent's Hospital, Los Angeles.

Guest speaker was Jerome H. Kay, M.D., chief heart surgeon at St. Vincent's, who showed two heart operation films and gave a lecture-demonstration of the Kay-Anderson heart-lung machine.

This is the second such evening program for the public which the chapter has held within the past few months. Judging from the success of both of these, it would seem that this form of program is well worth consideration by chapters who do not yet feel ready to give an all-day "institute" type of meeting.

In chronic respiratory disease...

"With simple exercise, aerosol therapy, and intermittent positive-pressure therapy, many of the diseases now classed as progressive may be slowed—many respiratory cripples may be returned to a useful life."

—Sadove, M. S.: J.A.M.A. 160:876 (March 10) 1956

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concluded from page 23

beaker so that we could catch the aerosol deposited and measure it in a colorimeter. We found that very little of it deposited, because of the surface tension of the droplets. Lowering this tension causes the droplets to splatter and spread out on the surfaces they strike. This can be accomplished by adding a detergent.

Again there is the question of how much would be best. One of the most effective and least toxic ones is Superinone, and the accompanying graph (Figure 3) shows the effect on droplet deposition of different concentrations of the detergent.

It is quite clear from these two graphs that the optimum stablization by glycerine and adjustment of surface tension by detergent are very quickly departed from by any dilution with water. Even slight dilution markedly decreases the stabilization and increases the surface tension. Therefore, Alevaire and other such solutions should be used full strength, as the concentrations of detergent and stabilizer are adjusted to be optimum only when undiluted.

ABSTRACT

"Dangers of Artificial Airways for Rescue Work," by Vincent J. Collins, M.D. and Gamaliel Saland, M.D., in *N.Y. State J. Med.*, **60**:388 (**60**).

"A number of reports have been received, indicating misuses of the airway: The tongue has been pushed back into the pharynx to create obstruction instead of correcting any existing obstructions, or the airway has been forced into the mouth when the jaws were clenched, producing unnecessary injury. To insert the airway is actually a matter of medical judgment. Vomiting and pulmonary aspiration have occurred, owing to stimulation of the gag reflex by the airway in patients not deeply comatose."

"Even in the hands of so-called professional rescue workers, the airway has lethal complications. In two instances, for which we have been consulted, analyses of the situations indicated that improper insertion of the airway in one instance had pushed the tongue back in the mouth; and in the second, the airway itself was occluded by the base of the tongue . . . *fatalities resulted in both instances.*"

In view of those reports, the authors and the Advisory Committee on Resuscitation to the New York City Fire Department have concluded that "airways in the hands of laymen are an extreme hazard, even though these men may actually be professional rescue workers."

—J.F.W.

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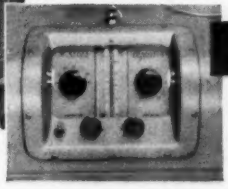

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note oxygen flowmeter (center), temperature and ventilation controls (left and right), oxygen controls (bottom).

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EDITOR'S CORNER

Hunger for Knowledge

SOME OF our chapters are really distinguishing themselves for the worthwhile things they are doing. Some others, however, are rather wondering *what* to do, or *how* to go about it.

Maybe a look at the AAIT's objectives makes it simpler: one of the chief reasons for our existing at all is for *Education*. I suppose that's why I've always felt that the most important person in a chapter isn't any one of the officers—it's the Program Chairman, or Education Committee Chairman, if your chapter calls him that.

It certainly is desirable to have an occasional meeting which is strictly business or social, with no educational program; but since these do nothing constructive professionally for the individual member, it is a great mistake to allow them to outnumber the ones at which there is a speaker, a film, a taped lecture, a demonstration or a panel discussion—a presentation from which the member can *learn* something.

With Registry examinations looming ahead, the matter of education becomes even more urgent than heretofore. Some chapters—the Florida one we know of—are holding more frequent meetings in order to cover more material in preparation.

Your Journal features abstracts and book reviews of current literature to help you keep abreast of what is available to you in print and where it can be located if you need to look something up. For many therapists it is probably a new experience to read abstracts and book reviews; but this is a desirable part of professional development.

A subsequent issue will carry a story on schools for training therapists, and we also will be running articles in the near future on standard texts, lists of films, taped lectures and other sources of information you'll want to take advantage of.

Texts are fine for individual study, but tapes and films are ideally suited to chapter meetings. Your chapter's medical advisers should be encouraged to attend these meetings and make themselves accessible for questions and discussion of the material presented. In this way, chapter meetings are of immense benefit to the individual member in a way which he couldn't possibly obtain from solitary study. This is the most cogent answer I can think of for the apathetic member who asks, "What can the chapter do for me?"

Another way in which education can be fun is in the planning and carrying-out of educational programs for the public or special groups like student nurses, internes or house staff. These can be limited to half day or evening presentations, like the Southern California chapter's recent ones, or they may be one- or two-day institute or workshop-clinic type programs, such as the Duluth hospitals gave in December, the Illinois chapter held in February and the two Michigan chapters jointly are holding in April (see page 24).

These things not only help inform the public or special audience they're given for, they indirectly help the individual member by gaining greater recognition, understanding and acceptance of his work. They also *directly* help the participants by giving them valuable experience.

Some chapters have complained of poor attendance at meetings. It is my contention that when a member finds he is going to get out of a meeting something which he can use in his work, he feels more like finding the time to attend.

Needs are Increasing

Thomas G. Murdough, president of the American Hospital Supply Corporation, in addressing a group of California investment and security analysts, stated that growing health needs of our country dictate the need for more than double the present number of hospital beds by 1985.

This estimate, he said, takes into account only the population growth, elimination of present backlog of bed needs, and replacement of facilities that become obsolete each year. It makes no allowance for greater numbers of people over 65, who require three times as much hospitalization as younger folk. Neither does it allow for steadily increasing numbers of people holding prepaid hospitalization, rising income levels, rising educational levels or continuing population moves from the farm into the city.

If other hospital services can be expected to increase like this, surely there will be a greater need for more and better inhalation therapy.

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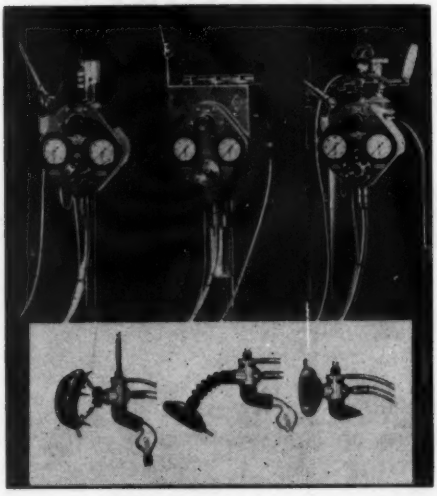
EQUIPMENT NEWS

(Information and photographs are supplied by the manufacturers or distributors.)

Bennett Units for Children

For use with infants and small children, Bennett Respiration Products, Los Angeles, now offers special versions of the Bennett Respiration Unit and Pressure Breathing Units.

Utilizing the exclusive Bennett "flow-sensitive" valve featured in the adult models, the three new



units feature minimum dead air space, flexible small bore main tube, miniature manifold and flex tube designed to be used in any position, reduced maximum flow, and interrupted nebulization. For adaptability, two Bennett infant masks (sizes 3 and 4) and a modified Bennett Type A small mask are supplied with each unit.

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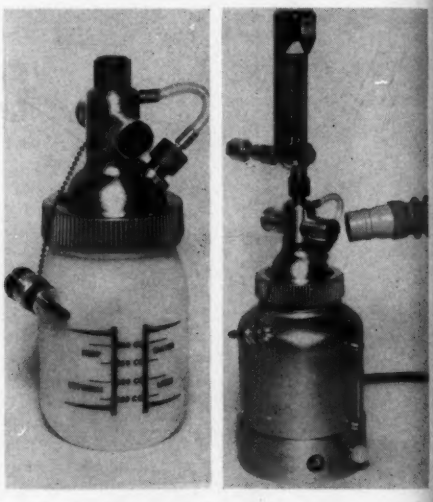
Mist-O$_2$-Gen OH-1 Humidifier

Mist-O$_2$-Gen Equipment Company, Oakland, California, announces the OH-1 Humidifier. Developed from their IPPB models, the OH-1 connects to all regulators or pipeline flowmeters in the conventional manner. A superior system of jet nebulization provides truly saturated oxygen for catheter or breathing tube, delivering up to 75 ccs of breathable, condensable aerosols and vapor humidification per hour. Medicated solutions or water may be used.

Mist-O$_2$-Gen says the OH-1 humidifier fitted with the TM-1 Tepid Mist reservoir is the only



unit nationally available bearing the Underwriters Laboratories approval. The unit is safeguarded by incorporating a 50 cm of water shrill whistle pressure relief and a 100 cm of water maximum relief.

Ordinary Mason jars may be used as reservoirs for the unit for cold mist humidification.

No. 522

Stephenson Demand Inhaler

The Stephenson Corporation of Red Bank, New Jersey, announces a new Demand Inhaler which they recommend for breathing patients who need high oxygen concentrations. It provides oxygen on inhalation only, the amount supplied depending on the patient's demand.

It is fully automatic and requires no dial setting. Its simple design and operation make it completely safe and easy to use.

If greater breathing assistance is necessary, pressing a button will deliver a continuous flow under slight positive pressure.

The unit features a special regulator which may be used on any style or size cylinder.

No. 523